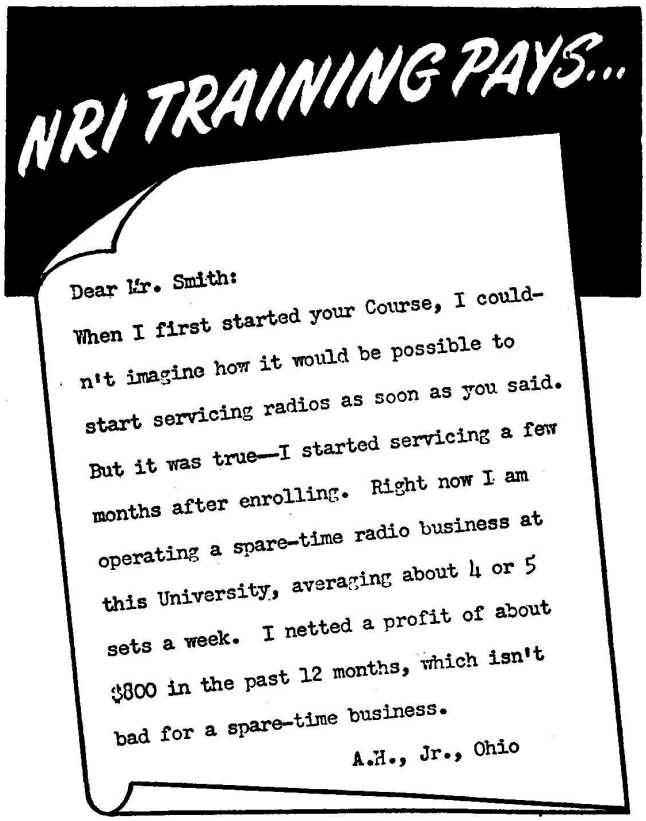
No. 5. How To Restring Dial Cords and Set Push Buttons

RADIO SERVICING METHODS



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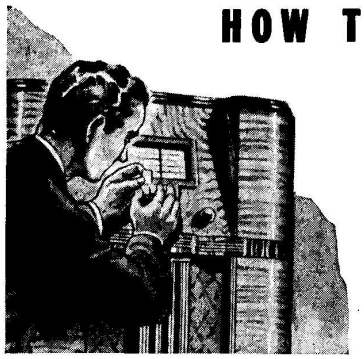


HOW TO RESTRING Dial Cords AND SET Push Buttons

MOST radio repairs call for considerable technical knowledge, but, if you have a little knack for mechanics, you'll be ready to take on two of the most common repair jobs as soon as you've finished this Booklet. We're going to show you how to repair dial drives, and how to set push buttons, which are two servicing jobs you'll be meeting all the time.

DIAL-DRIVE MECHANISMS

When you turn a knob to tune a radio, your action changes the settings of condensers or coils within the set, and also operates a mechanism that indicates the frequency to which the radio is tuned (usually by moving a pointer over a dial or a dial past a pointer). When we speak of the dial-drive mechanism, we mean the mechanical system that causes these actions when you turn the tuning knob.

Belt and cord drives are the two types in most common use today. Other kinds of drives have been used—particularly direct drives, in which the tuning knob is attached to the tuning condenser shaft, and friction drives, in which a rubber roller, secured to the tuning knob, bears against a dial secured to the tuning condenser shaft—but these systems are so simple that you can repair them without instructions.

Belt Drives. A typical belt drive is shown in Fig. *1*. As you can see, there are two pulleys, one mounted on

the tuning shaft, the other on the condenser shaft, over which an endless belt passes. Usually there is some way of controlling the belt tension; in the illustration, this is done by the idler pulley *P*, which is held against the belt by the spring *S* with enough force to create the desired belt tension.

Although the dial has been shown as transparent here so you could see how the system works, it is actually made of metal. The condenser shaft projects through a hole in the middle of the dial, and the pointer is fastened to the end of the shaft by a machine screw. The condenser pulley is mounted behind the dial.

Cord Drives. Cord drives are usually considerably more complicated than belt drives. Fig. *2* shows one of the simpler forms. Notice that the basic difference between this and the belt-drive system is that the dial cord (usually strong fishline or similar material) is securely fastened to the condenser pulley, or drum, instead of merely running around it as a belt does. In fact, the dial cord is brought down inside the condenser drum (through a slit in the drum rim) and is hooked to a spring that keeps it taut.

Besides connecting the tuning shaft and the condenser drum, the cord also passes over two small pul-

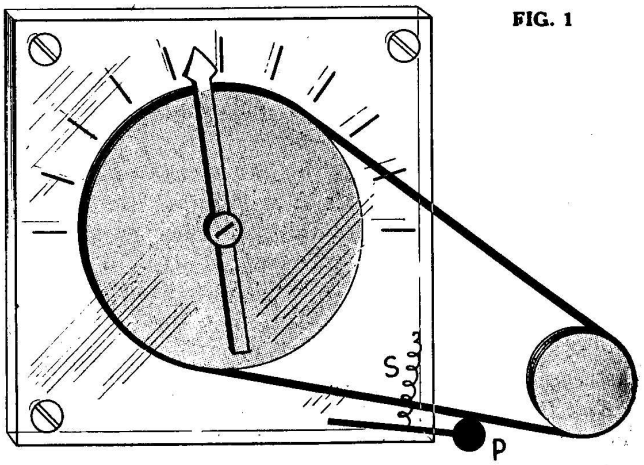


FIG. 1

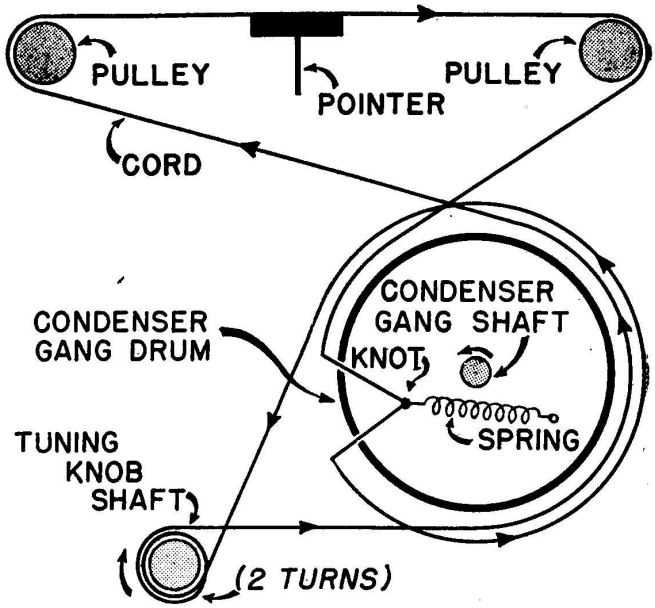


FIG. 2. A typical dial-drive system using a cord drive. The condenser gang shaft and the cord move in the direction shown by the arrows when the tuning knob is turned clockwise.

leys. A pointer is clamped to the cord in the length between these pulleys, and, as the arrows show, this pointer slides along a supporting edge from left to right when the tuning shaft is rotated clockwise. Thus, this system gives us a horizontal movement of the pointer instead of the rotating movement produced by a belt drive, and so permits use of the rectangular "slide-rule" type of dial that has become so popular.

Now let's see how to repair belt and cord drives when they become defective.

REPAIRING BELT DRIVES

The usual defect of a belt drive is that the belt slips, either because it has stretched or frayed, or because the idler pulley does not hold it under tension. There is usually some way to increase the tension on the belt. In the system shown in Fig. *1*, for example, the belt can be made tighter by shortening the spring that holds the

idler pulley against the belt. Sometimes the tuning shaft is in a slot, in which case the belt can be tightened by sliding the shaft in the slot. If the belt is stretched or frayed, however, it must be replaced.

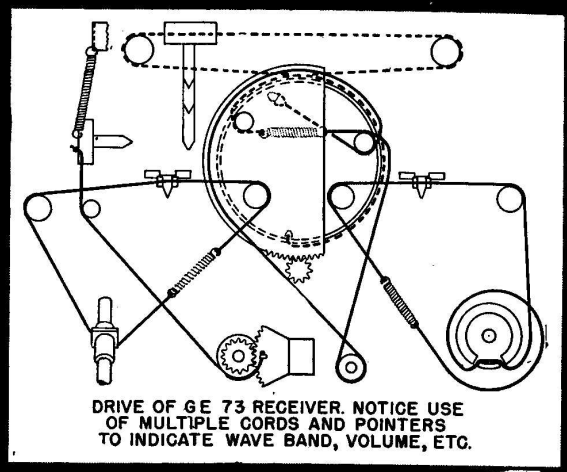
The important thing to watch in replacing a belt is that you have a belt of the right size. There are more than a hundred different sizes in use, and generally the wrong size will not work; either it will be too tight, in which case it will break very soon and make the set hard to tune in the meantime, or it will be too loose, and the tuning system will not work at all. The best way to get the right size is to order an exact duplicate belt for that particular receiver from either your supply house or the set distributor or manufacturer. The make and model number of the set are all you need to know to get the right belt from one of these sources.

► If an exact duplicate belt is not available, you will have to know the precise size of belt you want. One way to find this out is to cut the old belt and measure it carefully. Sometimes, though, the old belt will be missing, or will have stretched so much that a measurement won't give you accurate information. In this case, the best thing you can do is to run a silk cord (which will not stretch) over the pulleys to find the right length.

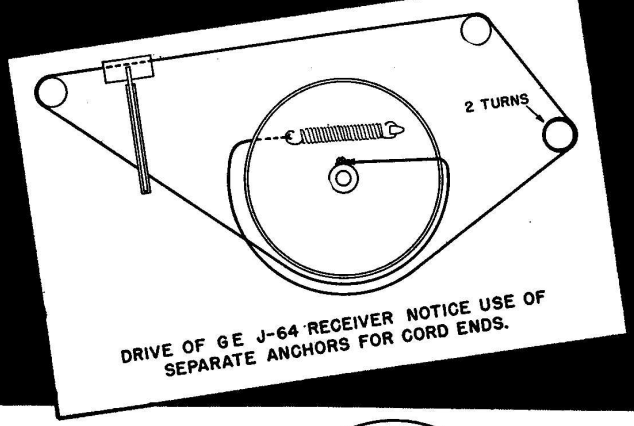
Installation of endless belts is easy. Usually you will have to remove the dial to put one on, and sometimes you must unscrew the bracket holding the tuning shaft so that its pulley can be moved closer to the condenser pulley; then the belt can readily be slipped over the pulleys.

REPAIRING CORD-DRIVE SYSTEMS

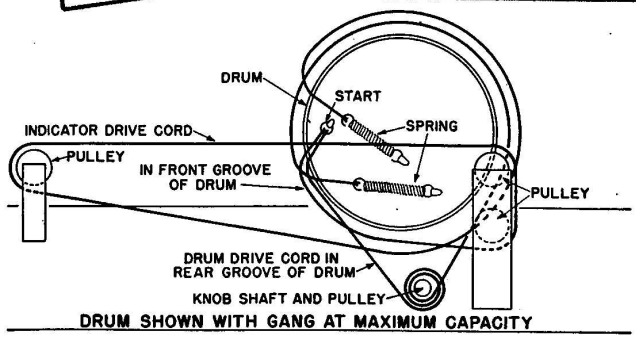
There are so many variations of cord-drive systems that a much larger book than this could not cover them all. However, each manufacturer usually issues diagrams showing how to repair and restring his sets; these diagrams, and your own mechanical ability, will let you repair almost any system. We've included a number of samples of manufacturers' diagrams in this Booklet to show you what they're like. It would be a good idea for you to build up a file of such information;



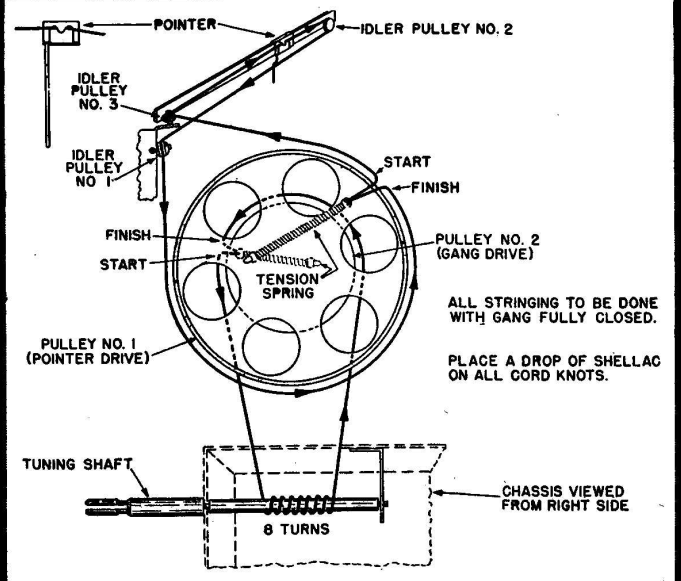
DRIVE OF GE 73 RECEIVER. NOTICE USE OF MULTIPLE CORDS AND POINTERS TO INDICATE WAVE BAND, VOLUME, ETC.



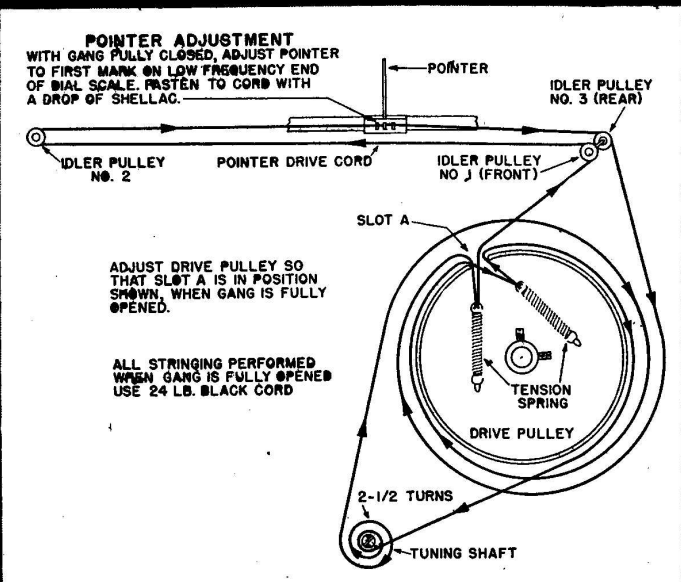
DRIVE OF GE J-64 RECEIVER NOTICE USE OF SEPARATE ANCHORS FOR CORD ENDS.



DRIVE OF RCA U-125 RECEIVER. NOTICE USE OF TWO DIAL CORDS.



DRIVE OF MOTOROLA 10IR2I RECEIVER. NOTICE USE OF TWO DRUMS SECURED TOGETHER.



DRIVE OF MOTOROLA 6IT23 RECEIVER. NOTICE THAT THE TWO DRIVE CORDS ARE COMPLETELY SEPARATE

you can always get the instruction leaflets from the manufacturer, and usually from his distributor.

We're not going to attempt to cover specific drive systems here. Instead, we are going to give you a series of service hints that apply to any system.

► The first is—*be sure you know what the drive is supposed to do.* If you have the manufacturer's diagram, or the old cord is still on the set, trace what happens when you turn the tuning knob. Before you remove the cord, if you don't have the manufacturer's diagram, make a sketch to show where the cord is supposed to go, with arrows to show the direction the cord and the pointer move when the tuning knob is turned. (Generally, but not always, the pointer moves across the dial from left to right, and the condenser gang opens, when the knob is turned clockwise.)

If the cord is not on the set, or has broken and been pulled off the pulleys, you may have to study the set carefully to figure out just what the system is supposed to do. Once you have decided how to make the repair, draw a diagram to show just what you intend doing. This will serve a double purpose: it will keep you reminded of how you are going to make the repair, and, if you find you are wrong, it will show you what *not* to do the next time.

The cord is usually wound around the tuning shaft at least twice, often more, and you must be careful to wind the correct number of turns on the shaft when you install a new cord. If you put on too few turns, the cord will probably slip; too many turns, on the other hand, will tend to bunch up and may jam the system. If the cord is gone, so you can't tell how many turns there should be, try using two or three.

What Cord to Use. Ordinary string or thin cotton fishline is *not* satisfactory, because it will stretch. If a thin cord is needed, silk or nylon fish cord is best. A cord with a Fibreglass core and a synthetic braid cover will also work well. Cords of medium thickness (diameter approximately .04 inch) are made of nylon, linen, or cotton; cotton cords of this diameter are satisfactory because they will not stretch at the tensions normally

used. Any fishline you use should have a breaking strength of at least 18 pounds.

Phosphor-bronze wire cords are also available. These are particularly useful in sets where the cord must move a heavy mechanical system. Heavy linen cords are also used in such installations.

Cords usually come in 10- and 25-foot lengths, wound on spools. You can get them from any radio supply house.

Common Defects. Several things may happen to cord-drive systems. The cord may lose tension, either because it stretches or because the tension spring does; the cord may slip; the pointer may stick; or the cord may jump off its pulleys, or fray, or break. Let's see what to do in each case.

Loss of Tension. If the cord is too loose, it will simply slip around the tuning shaft instead of turning with it. Usually this defect can be remedied by shortening the cord. One way is to knot it again at the point where it is attached to the tension spring inside the condenser shaft pulley. Always use a square knot (shown in Fig. *3*), which will not slip. You can put a drop of speaker cement, fingernail polish, or shellac on the knot as an added precaution against slipping.

Sometimes the cord is loose because the tension spring has stretched too much. If the spring allows the knot in the cord to come almost out of the slit in the condenser shaft drum, tighten the spring rather than shorten the cord. Inspect the end of the spring that is not hooked onto the cord. This end is anchored inside the drum, usually either to a bent-up metal ear or in a hole. There may be other ears or holes, farther from the slit, in which the spring can be anchored; if so, try one of them and see if the cord tension is sufficiently increased.

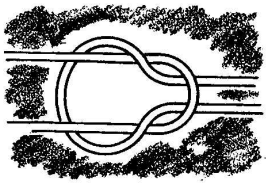


FIG. 3. This shows how to tie a square knot, which is the best knot to use to fasten the ends of a dial cord together. If you are not familiar with this knot, practice tying it a few times with this picture before you as a model.

If not, or if no other anchor points are provided, you can either shorten the spring or install a new one. To shorten the spring, cut off a few turns from the anchor end with a pair of cutting pliers, and bend the cut end to form a new hook.

If a shortened spring is still too weak, install a new one. The exact size is not important, but be sure it is strong enough so that it will not be stretched out of shape when it is installed—otherwise it will quickly lose its tension.

When you install a new spring, or shorten an old one, be careful not to let the cord slip off the pulley system —if it does, you may have to restring the whole drive. You can hold the cord in place by pressing your thumb firmly over the slit where the two parts of the cord emerge from the condenser shaft drum. If you need both hands for the spring, put a piece of scotch tape over the slit instead.

Be sure you seat the end of the spring firmly in its anchor hole or around its anchor post. Usually it's easiest to do this by grasping the end of the spring with a pair of needle-nose pliers, stretching it slightly past the anchor point, then allowing it to relax and guiding it into or around its anchor as it does so.

Slipping Cord. If the cord seems tight, but slips on the tuning shaft, probably grease or oil has gotten on it. You can remedy this condition by working powdered rosin into the cord. A commercial non-slip compound, having a rosin base, is available in stick and liquid form. This compound has the advantage that it shrinks the cord slightly in drying, thus giving increased tension as well as eliminating the effects of oil or grease.

Sticking Pointer. As we said earlier, cord drives are always used with slide-rule dials, in which a pointer moves horizontally over a long, rectangular dial that resembles a slide rule. If the pointer sticks or binds, the cord will get taut on one side of the pointer and loose on the other, and may jump off its pulleys; if the cord does not jump off, the tuning knob will at least be difficult to turn.

The pointer of such a dial usually slides along a metal

track on the edge of the dial, or on the dial plate edge itself. If the pointer sticks, inspect the track for burrs that may cause increased friction. Remove them with fine sandpaper, and spread a *light* film of vaseline over the track. (Don't get oil or grease on the cord.) Make sure the dial lights do not interfere with the pointer movement; if they do, bend their brackets slightly.

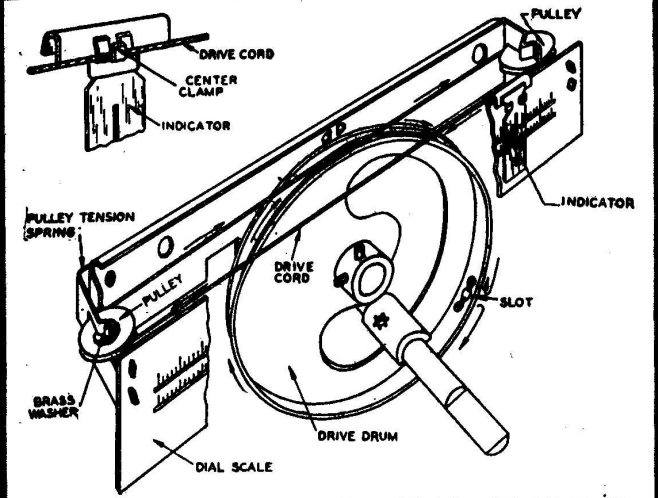
Cord Jumps Off Pulleys. Provided the cord is tight enough so that it should normally stay on its pulleys, the usual reason it jumps off is that it is caught somewhere in the system. Turning the tuning knob then tightens part of the cord and loosens part of it until the loose part finally slips off its pulleys altogether. The usual cause is a sticking pointer, as we just said. Whatever the cause, remedy it, then put the cord on again. Make sure that it is tight enough to stay.

Frayed or Broken Cord. Either of these must be replaced. The broken cord is usually harder to replace, because the drive system will probably be completely unstrung, and you will have to figure out how the system works. Replacement is not difficult if you have the manufacturer's sketch of the stringing arrangement. If you do not, be sure to make a diagram of the system. If the cord is frayed but still in place, make the diagram before you remove it.

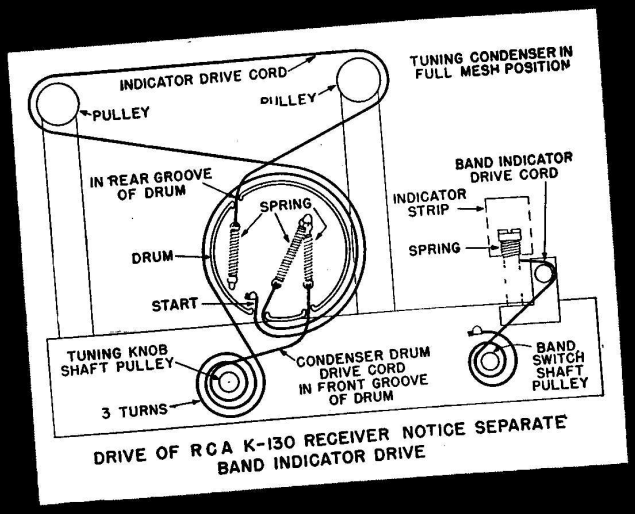
Turn the condenser gang either fully closed or fully open (maximum or minimum capacity) before you start restringing, then string the drive in a direction such that any tension you put on the cord will tend to keep the condenser in position. This will let you pull the cord taut during the operation without fear of its slipping. Manufacturer's instructions usually specify whether the gang is in or out for the direction of stringing shown. (Be sure you cut enough cord off the spool to do the job. It's better to waste a few inches than to have to waste the whole piece because it is short by half an inch.)

Finally, connect the pointer to the cord in a temporary manner. (Most pointers clip on the cord, but in some systems the cord is wrapped around a stud on the pointer slider.) See that it is at the high-frequency end of the dial when the condenser gang is full out, and goes toward the low-frequency end when the gang is turned in. You may have the system strung backwards, in which case all you can do is try to smile and do the job over.

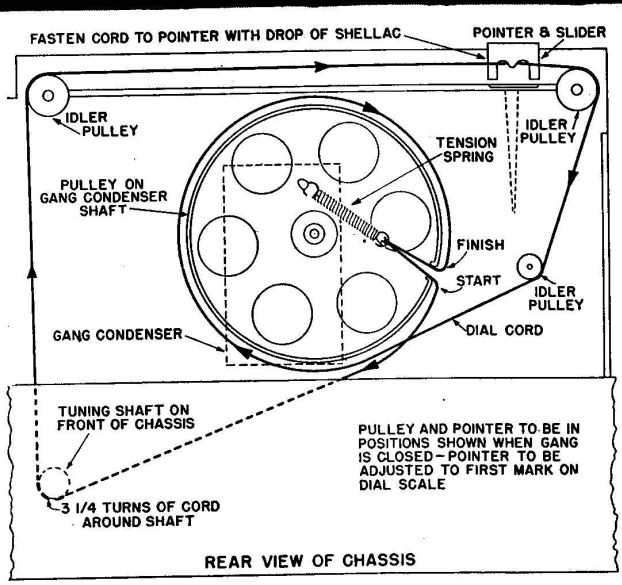
Turn on the set and check the accuracy of the pointer setting. If necessary, adjust the pointer position until both the frequency of the station being received and the frequency indicated by the pointer are exactly the same. Then, place a drop of speaker cement or collodion on the pointer clip to bind it to the cord. It's worth while to take a little trouble with this, because your customer may find it irritating to have the pointer indication even a little off what it should be. In fact, you can demonstrate to him how accurately the pointer is set when you're finished.



DRIVE OF GE-U51 RECEIVER. NOTICE USE OF FLAT SPRINGS TO HOLD PULLEYS.



DRIVE OF RCA K-130 RECEIVER NOTICE SEPARATE BAND INDICATOR DRIVE



DRIVE OF MOTOROLA 51F12 RECEIVER NOTICE USE OF EXTRA IDLER PULLEY

Setting Up Push Buttons In Radio Receivers

Automatic tuning, in which a set is tuned to a desired station simply by pressing a push button, has become an almost universal feature. Adjusting the push buttons is an easy job, but one a set owner seldom attempts. If the button doesn't bring the station in "on the nose," or if he wants a different station, he will usually call in a serviceman.

► There are three main types of automatic tuning systems—*electrical, mechanical,* and *electro-mechanical.* In an electrical system, pushing in the button switches a preadjusted set of trimmer condensers or adjustable inductances (coils) into the tuning circuits of the radio, and, at the same time, releases any button previously pushed.

In a mechanical system, the motion produced by pushing in the button actuates a lever system that turns the regular gang tuning condenser of the set to the desired station.

► In an electro-mechanical system, pushing in the button (or, in some systems, turning a telephone-type dial) starts a small electric motor that turns the gang tuning condenser to the desired station. This is the only system that is particularly complicated. We're going to cover this system and its variations further along in your regular Course. It would be best for you not to attempt to adjust an electro-mechanical system until you've studied the lesson on automatic tuning systems—unless you have the manufacturer's adjustment instructions for the set in question. These instructions are usually complete enough for you to make the adjustment without difficulty, if you follow them closely.

However, electro-mechanical tuning is used in but few modern sets. In this Booklet, we're going to explain how to adjust electrical and mechanical systems—the kind servicemen are called upon to adjust almost every day. We will give you the general procedure for all sets instead of instructions for just a few specific radios. You can easily take care of any small variations you find in a particular set. Our instructions will be for setting up all the buttons in a set; if you're interested in

adjusting just one button, follow the procedure only until that button is set up.

ADJUSTING ELECTRICAL SYSTEMS

If you have the manufacturer's instructions for the set you're working on, read them carefully. They may contain some short-cut methods that apply only to that set (which, of course, we will not give here). If you don't have them, the method described in the following paragraphs will work perfectly well.

First, turn on the set and let it warm up for at least twenty minutes. This will prevent drifting of the adjustments after the set reaches operating temperature.

While you're waiting for the set to warm up, count the number of buttons available for station selecting. Ignore any that are used for other purposes (for turning the set on and off, for manual tuning, for phonograph operation, etc.). Have the customer select a corresponding number of stations. These should be local or medium distant stations that can be received well. (Naturally, if you are merely readjusting buttons that have drifted off their settings, you will reset them to the originally selected stations unless the owner wants a change.) Look up the frequency of each station in a log book or the radio listings in the newspaper, then list each station in order of increasing frequency (lowest frequency first on the list).

► Next, locate the trimmer adjustments on or above the chassis (or directly behind the push buttons). There will be two of these for each button, and they will be marked to indicate the frequency range to which they can be tuned. (For an example, see Fig. 4.) Assign a station to each button on the basis of these frequency ranges, then make a rough sketch to show which station has been assigned to each button. If the customer has selected a station for which no tuning trimmers are available, (or two stations that need the same set of trimmers), have him pick some other station (or one of the two) and tell him he'll have to use manual tuning for the one you cannot set up.

You can usually reach these trimmer adjustments from the back of the cabinet, sometimes by removing a

back cover. On a few sets, you can reach them from the front of the cabinet by removing either a cover plate or the escutcheon plate through which the push buttons protrude.

When the set has warmed up sufficiently, you're ready to adjust the first button. Tune the set manually to the station selected for the button, then press in the button. Now turn the *oscillator* trimmer (sometimes called the tuning or station-selecting trimmer) for that button until you get the same program. (You can identify the oscillator trimmer by the fact that you will hear several stations as you turn the adjusting screw.)

Next, turn the other trimmer (usually called the *antenna* trimmer) for that button until maximum volume is produced. This is not a critical adjustment. Readjust the oscillator trimmer carefully until the station is perfectly tuned. Return the set to manual tuning to make sure the station is heard at least as well on automatic tuning as it is on manual. (Usually the automatic tuning will be slightly better, since the trimmer condensers can be adjusted more accurately than the gang tuning condenser.)

This completes the set-up for one button; adjust each other button in exactly the same way. Since there's always a chance that you have tuned a button to another station carrying the same program as the one you want, check your work by pressing one button after another during the station announcement period. If the station you want is a local, you can readily check by comparing the background noise heard on automatic and manual tuning; if the background is much noisier on automatic tuning, you probably have tuned to some other station on the network.

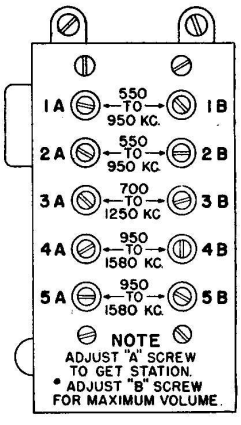


FIG. 4. Typical trimmer adjustments. The oscillator trimmers (marked A) are at the left, the antenna trimmers (marked B) at the right. In some radios, one set of trimmers is above the other.

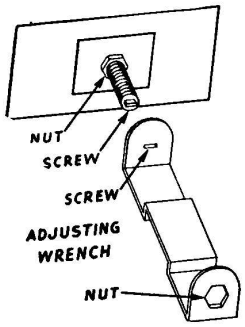


FIG. 5. Coaxial trimmers. The nut adjusts the antenna trimmer, the screw adjusts the oscillator trimmer.

Precautions and Hints. Never turn a trimmer condenser screw more than a few turns out (counter-clockwise) or it will fall out. Never apply force to a screw.

If you can't bring a station in with the oscillator trimmer, loosen the antenna trimmer a turn or two and try again.

► You may sometimes meet coaxial (one inside the other) adjustments like that shown in Fig. *5*. Special wrenches are made for these, like the one shown.

► Adjustable inductances called *permeability-tuned coils* are often used in place of trimmer condensers. A typical one is shown in Fig. *6*. To produce the same change in frequency, the adjusting screw of a permeability-tuned coil must be turned many more times than that of a trimmer condenser.

ADJUSTING MECHANICAL SYSTEMS

There are two types of mechanical automatic-tuning systems. In one, the rocker-bar type, each button has its own locking adjustment. In the other, the cam-and-

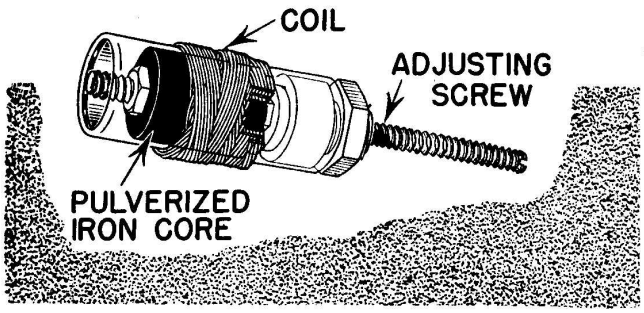


FIG. 6. Permability-tuned coils like this are used in many sets in the oscillator circuit. Once tuned, such a coil will usually stay in adjustment for a long time.

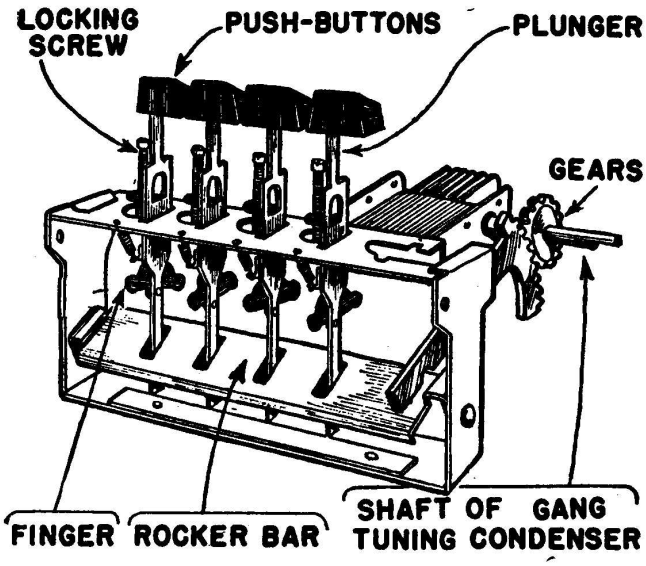


FIG. 7. Rocker-bar tuning mechanism. Since this is a mechanical system in which movement of a push button turns the shaft of the tuning condenser, you must push buttons in all the way to get the desired stations. Pushing the button in only part way will not turn the tuning condenser enough. Be sure your customers understand this.

lever type, one locking adjustment takes care of all the buttons.

Rocker-Bar Mechanisms. A typical rocker-bar mechanism is shown in Fig. *7*. The rocker bar is a flat pivoted metal piece that is connected to the gang tuning condenser through a gear system in such a way that the *angle* to which the rocker bar is rotated determines the condenser setting. Each button is on a plunger that goes through a slit in the rocker bar. On each plunger is a metal finger that can be set to any desired angle by adjusting a screw. When a button is pushed, the finger on its plunger bears on the rocker bar and turns the bar to the same angle as the finger; this changes the setting of the gang tuning condenser, and so tunes the radio.

To set up the buttons of a rocker-bar system, take the same initial steps as you do with an electrical sys-

tem: turn on the set and let it warm up, have the stations selected, then list them and assign them to buttons. You don't have to consider tuning ranges, because any button can tune any station. It is usually best, but not actually necessary, to assign stations to the buttons from left to right in the order of increasing or decreasing values of frequency.

While you wait for the set to warm up, locate the adjusting screws. These are always accessible from the front of the receiver, but you may have to remove the push buttons, remove the station tabs from the buttons, remove the station tabs from the escutcheon (the ornamental plate around the buttons on the panel), or remove the escutcheon to get at them. In some sets, the push buttons themselves serve as the adjusting screws. If you have the manufacturer's instructions, they will tell you where the screws can be found.

Set up each button as follows: Back off its adjusting screw. Press the button in and hold it in. Carefully tune in the station desired for that button with the manual control. Run in the adjusting screw as far as it will go. Release the button.

That's all you need do to set up one button; set up each of the others the same way. Check your work when you're through by pressing each button in turn.

Cam-and-Lever Mechanisms. A typical cam-and-lever mechanism is shown in Fig. *8*. The cams—heart-shaped metal discs—are secured to an extension of the gang tuning condenser shaft by friction washers. A single locking adjustment, when tightened, locks all cams to the shaft simultaneously. The push buttons are mounted on the ends of pivoted levers. When a button is depressed, a roller on the other end of its lever is forced against one of the cams; this turns the cam, and the shaft to which it is locked, to the point where the roller reaches the bottom of the V of the cam.

To set up one of these systems, take the same initial steps you would for a rocker-bar mechanism: First, warm up the set and assign stations to buttons. Then locate the locking adjustment. This may be a screw in the center of the manual tuning knob, as it is in the

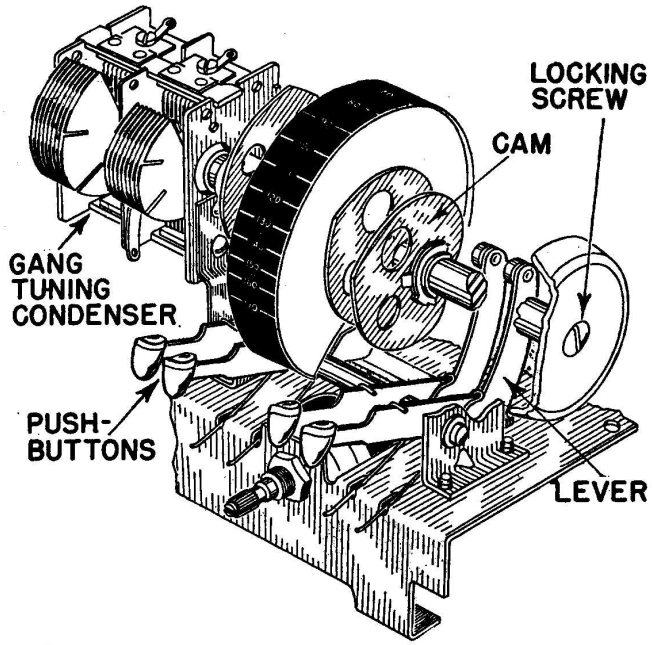


FIG. 8. Cam-and-lever mechanism. Mechanical systems like this one and the rocker-bar mechanism (FIG. 7) are used mostly in small and inexpensive sets. They seldom have more than four or five push buttons.

mechanism in Fig. *8*, or a knurled screw on the side of the receiver, a wing nut on the side of the dial assembly, a screw accessible from the back of the receiver, a screw exposed by removing the push-button escutcheon or removing a snap-in button on the escutcheon, or a screw reached through a hole located below the tuning unit. Sometimes the tuning knob itself must be pushed in or pulled out, then turned, to unlock the cams. The manufacturer's instructions, if you have them, will show you where the adjustment is.

Once you have found the adjustment, loosen it. Firmly push down the first button to be set and carefully tune the set to the desired station with the manual control. Be sure to hold the button depressed until you are through tuning. Then release the button, *but do not*

touch the locking adjustment. Repeat the process until all the buttons have been set up; then, and only then, tighten the locking adjustment.

FINISHING UP (ALL SYSTEMS)

No matter what kind of automatic tuning system you adjust, be sure to give it a final check by comparing push-button reception with manual-tuning reception for each station. If manual tuning produces better reception on any station, readjust the automatic tuning for that station.

A sheet of tabs on which are printed the call letters of all U. S. stations is usually supplied with automatic tuning sets. After setting up the buttons, secure the appropriate tab for each on the button or in the escutcheon surrounding them. When call-letter tabs are not furnished, get the sheets from the distributor of the set or from your radio parts supplier.

► Whenever possible, demonstrate the set to the customer in his own home. Press each button to show that it works as it should, and make sure he knows how to operate the automatic tuning system. You may think that anyone can operate automatic tuning—but a surprisingly large number of people don't realize that the buttons must be pressed in all the way in a mechanically-tuned set, and some even forget that an electrically-tuned receiver must be switched from manual to automatic and vice versa. You'll build good-will, and save unnecessary call-backs, by giving a short demonstration of every set you adjust.